U.S. Department
of Transportation

Federal Aviation
Administration

Advisory Circular

Subject: HIGH-SPEED TIRE MAINTENANCE AND OPERATIONAL PRACTICES

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Initiated by: AFS-340

AC No: 20-97A
Change:

1. PURPOSE. This advisory circular (AC) provides information and guidance for operating and maintaining aircraft tires to ensure their continued airworthiness.

2. CANCELLATION. AC 20-97, High-Speed Tire Maintenance and Operational Practices, dated January 28, 1977, is canceled.

3. RELATED READING MATERIALS.

a. Tire manufacturer's maintenance and repair instructions (available from the tire manufacturer).

b. AC 65-15A, Airframe and Powerplant Mechanics Airframe Handbook section entitled, Aircraft Tires (SN-050-007-00391-9, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402).

c. AC 121.195(d)-1, Alternate Operational Landing Distances for Wet Runways; Turbojet Powered Transport Category Airplanes (available from U.S. Department of Transportation, Utilization and Storage Section, M-443.2, Washington, D.C. 20590).

d. Order 8110.8, Engineering Flight Test Guide for Transport Category Airplanes (available from Federal Aviation Administration (FAA), Document Inspection Facility, Attention: APA-420, 800 Independence Avenue, SW., Washington, D.C. 20591).

4. BACKGROUND. The results of recent testing and analysis of large tires used on commercial aircraft indicate that their service life and continued airworthiness can be enhanced by the application of improved operation and maintenance practices. The analysis revealed that, while foreign object damage is still a major cause of tire failure, high temperatures caused by normal operation have an important effect on the service life of tires. Operational practices of flight personnel and maintenance personnel can have a significant influence on reducing the harmful effects of temperature and contribute to the extension of the safe service life of tires.

5. SERVICING. Improved tire airworthiness depends on an effective and vigorous maintenance program which utilizes the knowledge and resources of the operating and servicing personnel, the tire manufacturer, and the retreader.

a. Tire inflation pressure should be checked daily on all aircraft. Pressure checks should be accomplished using an approved, properly calibrated pressure gauge and should be carried out on tires when they are cold. If tires are hot, higher pressures than specified will be observed. In this case, air should not be bled from the tires. For hot inflation checks, the pressure of all tires should be compared. Any large discrepancies (over 20 PSI) in pressure should be noted, rechecked, and corrected later when the tires are cold.

b. Procedures for recording tire service should be established to aid in identifying chronic leakage problems. Tires with excessive leakage should be removed from service.

c. A list of factors to be considered when setting up procedures or when checking inflation pressure is as follows:

(1) Inflation pressure under load will be 4 percent higher than unloaded inflation pressure.

(2) A new tire will expand and consequently lose inflation pressure. Accordingly, it should be held for 12 hours and reinflated before being placed in service.

(3) A change of 5°F (2.5°C) in ambient temperature will alter the pressure of a tire about 1 percent.

(4) Most airlines specify tolerances for inflation pressures. It is especially important that the inflation pressures of tires on the same bogie be identical.

(5) If a tire is checked and found to have less than the minimum pressure, the following table gives the recommended disposition of the tire:

Tire Pressure	Recommended Action
More than 85 percent of service pressure	Reinflate
70 to 85 percent of service pressure	Remove tire from aircraft
Less than 70 percent service pressure	Remove tire and its mate
Blown fuse plugs	Return for retreader's inspection

(6) Aircraft tires lose air from diffusion into the carcass. Diffusion should not exceed 5 PSI per day. Tires exceeding this rate represent a hazard and should be removed from service.

(7) Few tire explosions, as opposed to tire burst or tire failure, have occurred in service. The failure mechanism of a tire explosion is thought to be brought about by overheating of the tire or brake or combinations of these. The heat causes hydrocarbon gasses to be generated inside the tire from overheated rubber (around 50°F) or hydrocarbon contaminants (grease, oil, hydraulic fluid, etc.). These hydrocarbon gasses mix with the high pressure air and ignite. The use of nitrogen to fill and maintain the tire pressure will prevent the explosive mixture from forming. Moreover, evidence exists that tires inflated with air have shortened service life because the air diffusing into the carcass degrades its inner-ply adhesion. Nitrogen is also a deterent to wheel corrosion.

d. A tire removed from service should be carefully inspected by a FAA-certificated repair station rated for retreading of high-speed aircraft tires. Procedures for recording tire servicing should be established to assist in improved maintenance. The history of a tire is important to the retreader in establishing the degree of airworthiness of that tire. Accordingly, tire service records should be readily available to the retreader and should be forwarded when the tire is returned for retreading.

e. High temperatures are a threat to tire airworthiness. During their life, tires are subjected to stresses which cause elevated temperatures. Paragraph 8 describes factors which cause excessive tire heating. Analysis has shown that continued exposure to temperatures as low as 220°F (104°C) can shorten the service life of a tire. Hence, care should be taken to avoid conditions which will result in tire temperature buildup. The following should be considered in determining whether tires have been exposed to excessive temperatures:

(1) Overdeflection of tires is caused by underinflation or overload. A tire located adjacent to a failed tire on the same bogie should be removed for inspection by a qualified repair station.

(2) Variations in outside diameter (OD) of dual tires can cause excessive load to be transferred to the larger OD tire. Outside diameters of dual tires should, therefore, be matched in accordance with the following table:

OD Range of Tires	Maximum Tolerance
Up to 24"	1/4"
25" to 32"	5/16"
33" to 40"	3/8"
41" to 48"	7/16"
49" to 55"	1/2"
56" to 65"	9/16"
66" and up	5/8"

f. Safety practices and precautions recommended by the tire manufacturer, or other approved programs, should be strictly observed by persons servicing tires.

6. INSPECTION PROCEDURES. A rigorous tire inspection program should be developed to meet the requirements of the intended operation. The operator should ensure that the program is being complied with, including strict adherence to tire damage criteria. AC 145-4 when revised will contain minimum damage criteria for both repairable and nonrepairable tires. The following factors should be considered when inspecting tires in service:

a. Tire wear has an important bearing on judging the type of previous service and whether removal is necessary. Tires worn abnormally can reveal overinflation, underinflation, landing gear or wheel problems, and sometimes, problems with an adjacent tire on the same bogie.

b. Cuts from foreign object damage (FOD) should be carefully observed. Any damage exceeding approved removal criteria should be noted and the tire removed. Note: Do not probe cuts or embedded foreign object damage when the tire is inflated.

c. Tread rubber reversion, skid marks, and many other evidences of damage each have unique characteristic patterns usually described in the care and maintenance manuals which the FAA requires tire manufacturers to provide. These can be of great assistance in determining the airworthiness of a tire.

d. Cuts, cracks, bulges, etc., should be marked with crayon or chalk before deflation, since they may disappear when the tire is deflated.

e. Evidence of brake heat such as bubbles and discoloration can sometimes be found in the bead area of a mounted tire; however, it is usually necessary to remove the tire to find evidence of such damage. Any tire believed to have been exposed to excessive brake heat should be removed and examined in the bead seat area for evidence of cracking and rubber reversion. If a question exists, the tire should be removed from service and inspected by an FAA-certificated repair station rated for retreading of high-speed aircraft tires.

7. FOREIGN OBJECT DAMAGE AND AIRPORT CONDITION. Airport managers and aircraft operators/owners are encouraged to keep airport ramps, runways, taxiways, and hangar floors free from debris which can damage tires. Regularly scheduled cleaning should be accomplished, preferably daily. Condition of the airport runway surface is important; poor runway conditions should be reported and attended to, since they are likely to cause tire damage that could lead to tire failure, premature removal, or scrapping of otherwise serviceable tires.

8. OPERATIONAL PROCEDURES. Flightcrews and maintenance personnel taxiing or towing aircraft should observe aircraft manufacturer's recommended operational procedures. It is always prudent to use large radius turns and low speeds to prevent shoulder damage, tread scrubbing, and overheating. Nosewheel tires are sometimes subjected to short-turn maneuvers which can cause bead unseating and loss of inflation pressure.

a. The following factors should be considered when evaluating the impact of operational procedures on the service life of tires:

(1) Tires on aircraft normally used over long taxi distances or at high gross weights, or a combination of these conditions, are susceptible to shortened service life from heat buildup. If these conditions are excessive, tire failure,

thermal fuseplug release, or tire burst may occur during or after takeoff or during a rejected takeoff.

(i) From 1960 through 1978, transport certification flight test procedures specified that the fuseplug no-melt test (maximum landing weight braking tests) and the fuseplug melt test (maximum energy rejected takeoff breaking tests) be conducted using a 2-mile taxi. FAA Order 8110.8, Engineering Flight Test Guide for Transport Category Airplanes, contains pertinent information relative to test procedures used therein and is available through instructions given in paragraph 3. Beginning in 1979, a 3-mile taxi was specified for both fuseplug tests. Breaking performance and turnaround procedure times were based on these taxi distances. If longer taxi distances are used, those performance and operating procedures would become invalid because of higher tire temperatures involved. One solution would be to eliminate or prevent the heat rise in the tires caused by the longer distance taxied. Eliminating the heat rise could be accomplished by a cooling period after taxiing out and prior to takeoff. Preventing the heat rise may be accomplished by using reduced takeoff weights and/or reducing taxi speeds. Combinations of these procedures may be feasible.

(ii) Relatively limited bias tire data is available on tire heating. For that reason, the heating and cooling data provided herein may be overly conservative. Other more specific data provided by the manufacturer or operator may be valid.

(A) To calculate heat rise, add the following:

(1) 30°F per mile for the first mile beyond a taxi distance of 2-miles for airplanes certificated using the 2-mile taxi distance.

(2) 15°F per mile beyond a 3-mile taxi.

(3) 30°F for every taxi stop beyond three total taxi stops.

(4) One-half the difference between ambient temperature above 70°F.

(B) To calculate additional cooling required after taxing out and prior to takeoff, use a cooling rate of 100°F per hour.

(C) To calculate additional cooling time, over and above flight manual cooling or turnaround, use 50°F per hour when a rejected takeoff has been conducted after taxiing beyond the demonstrated 2- or 3-mile taxi.

(D) To reduce tire temperatures by using a reduced taxi weight, the manufacturer or operator will need to submit data verifying their procedures.

(2) Large transport aircraft tires are normally scrapped after five to seven retreads. Tires on heavily loaded aircraft that taxi long distances are susceptible to severely reduced service life from the cumulative effects of elevated temperatures. Tires subjected to such conditions may have to be scrapped after fewer retreads to

prevent tire failure during or after takeoff or during a rejected takeoff.

(3) Tires exposed to abnormal energies during rejected takeoff should be removed from the aircraft and scrapped.

(4) Using brakes that are worn beyond limits would cause progressively higher temperatures for the same energy to be dissipated. This may cause the tire bead seat to deteriorate. Tires should be removed for inspection and replaced, if necessary, when exposed to brakes that are worn beyond limits.

(5) For alternate operational landing distances on wet runways for turbojet powered transport category airplanes, see AC 121.195(d) (see paragraph 3 for availability).

b. Hydroplaning may occur on a wet or icy runway and, in addition to loss of braking friction and loss of control, can cause severe tread damage.

c. Chevron cutting is superficial damage to a tire, generally from crosscutting of runways to permit drainage and elimination of hydroplaning. Chevron cutting is not considered severe damage but, nevertheless, causes shortened service life.

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